

APPENDIX D

**INTERIM REPORT ON TASK 4:
FINAL ECONOMIC AND STRATEGIC FEASIBILITY STUDY**

PACIFIC MISSILE RANGE FACILITY COMBINED HEAT AND POWER FEASIBILITY STUDY

INTERIM REPORT ON TASK 4 Final Economic and Strategic Feasibility Study

Prepared For:

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Office of Economic Development
Kauai, Hawaii

Prepared By:

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January 2007

**PACIFIC MISSILE RANGE FACILITY
COMBINED HEAT AND POWER FEASIBILITY STUDY**

INTERIM REPORT ON TASK 4

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**PACIFIC MISSILE RANGE FACILITY
COMBINED HEAT AND POWER FEASIBILITY STUDY**

INTERIM REPORT ON TASK 4

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SECTION 1

INTRODUCTION

The interim report on Task 3, titled “Findings and Recommendations on the Economic Evaluation of Alternatives,” recommended that Alternative No. 2-B be implemented. Alternative No. 2-B contemplates construction of a landfill gas fired CHP facility at the location of the existing PMRF power plant, the installation of a landfill gas compression skid at the landfill, and the installation of a 3.9-mile landfill gas transmission pipeline, between the landfill and the PMRF power plant.

Task 4, which this report addresses, calls for the following items:

- Preparation of an optimized project configuration;
- Evaluation of economic feasibility;
- Recommendations on measurement, verification, and monitoring;
- Discussion of operation and maintenance considerations;
- Preparation of schematic equipment layouts;
- Identification of major equipment selection;
- Development of a project implementation plan; and
- Development of a project implementation schedule.

SECTION 2

OPTIMIZED CONFIGURATION

Summary of Recommended Project

The recommended project consists of the following major components:

- Installation of a landfill gas collection system at the Kekaha Landfill. The landfill gas collection system will consist of 39 landfill gas extraction wells, and related piping, as is more fully described in Section 5 of the “Interim Report on Task 1;”
- Installation of a landfill gas processing skid at the landfill. It will have a design capacity of 600 scfm and an operating pressure of 25 psig. It will chill the landfill gas to 45° F and reheat it to 65° F prior to introduction into the pipeline. A tentative location for the skid is shown on Figure No. 5-2 in Section 5 of the “Interim Report on Task 1;”
- A 3.9-mile, 6-inch diameter, landfill gas transmission pipeline from the landfill to the site of the existing PMRF power plant. The general alignment of the pipeline is shown on Figure No. 6-1 in Section 6 of the “Interim Report on Task 1;”
- A 1,640 kW landfill gas fired CHP plant, located adjacent to the existing PMRF power plant. The CHP plant will employ two 820 kW reciprocating engines, and engine appurtenant equipment, heat recovery equipment, and an absorption chiller. Table No. 2-1 provides a summary of the major equipment that will be employed at the CHP plant. The CHP plant would interconnect into the PMRF power distribution system at the existing PMRF power plant;
- Chilled water delivery equipment and piping to supply chilled water to Buildings 130, 105 and 105ROCS. The existing cooling equipment would remain at these locations to provide supplemental and standby cooling; and
- A 12.47 kV electrical distribution line, about 13,800 feet in length, between the PMRF power plant and the Navy Housing area, to allow the Navy Housing area to receive power from the CHP plant. Implementation of this element of the project requires resolution of certain power distribution line ownership issues in the Navy Housing area. These issues are discussed in Section 5 herein.

PMRF will probably keep the current PMRF power plant active in order to provide standby power.

Schematic Equipment Layout

The following figures are bound in the rear of Section 2:

- Figure No. 2-1: Process Diagram for Landfill Gas Compression Skid;
- Figure No. 2-2: Process Diagram for CHP plant;
- Figure No. 2-3: Schematic Site Plan for CHP Plant; and
- Figure No. 2-4: Schematic Equipment Layout for CHP Plant

Selection of Major Equipment

It is recommended that two Caterpillar 3516 reciprocating engines be employed. The engines have a gross power output of 820 kW and a gross heat rate of 10,900 Btu/kWh (HHV).

The final decision on the make and model of all other equipment should be made during detailed design and/or during construction. Table No. 2-1 lists other major pieces of equipment, along with their preliminary design ratings, and possible equipment suppliers.

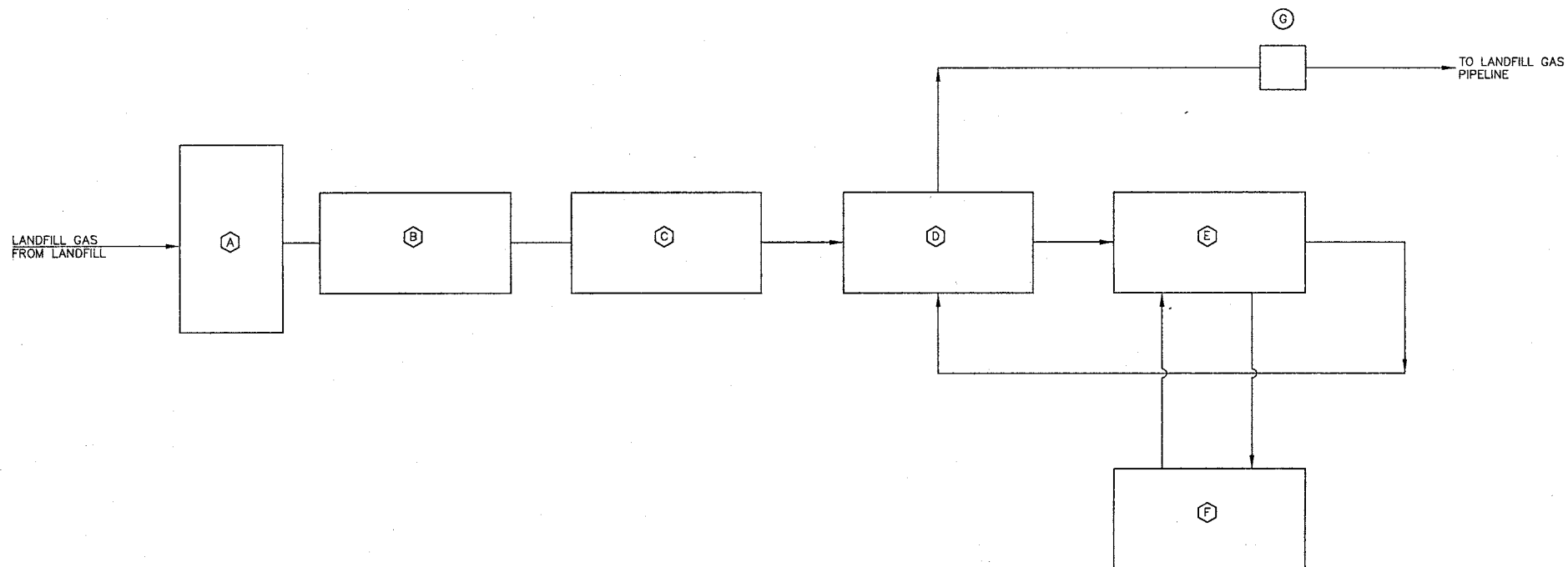
**TABLE NO. 2-1
SUMMARY OF MAJOR EQUIPMENT**

Equipment at Landfill	Design Criteria	Possible Suppliers
Landfill Gas Compressor	600 scfm. -50" wc inlet. 25 psig outlet. Sliding vane type.	AC or Fuller
Landfill Gas-to-Air Heat Exchanger		Americool
Landfill Gas-to-Landfill Gas Reheat Heat Exchanger		Elanco
Landfill Gas-to-Chilled Water Heat Exchanger		Elanco
Coalescing Filter (at Landfill Gas Skid)	5 microns at 99%. One at 600 scfm.	Dollinger

Equipment at Power Plant	Design Criteria	Possible Suppliers
Coalescing Filters (at Engines)	5 microns at 99%. Two at 300 scfm.	Dollinger
Hot Water Heat Exchangers at Engines		ITT
Hot Water Generators on Engine Exhaust		Cain Industries
Air-to-Water Excess Heat Heat Exchanger		AKG
Radiators for Engines		Young Touchstone
Absorption Chiller	280 tons	ITT

TABLE NO. 2-1 (continued...)
SUMMARY OF MAJOR EQUIPMENT

Equipment at Power Plant	Design Criteria	Possible Suppliers
Cooling Tower		Marley or BAC
Hot Water Pumps		ITT
Chilled Water Pumps		ITT
Chilled Water Heat Exchangers at Buildings		ITT
Switchgear	5 kV	ISO
Protective Relay Package	To satisfy KIUC requirements	Switzer or GE



A	MOISTURE SEPERATOR
B	SLIDING VANE COMPRESSOR
C	GAS-TO-AIR HEAT EXCHANGER
D	GAS-TO-GAS HEAT EXCHANGER
E	GAS-TO-WATER HEAT EXCHANGER
F	CHILLER
G	COALESCING FILTER

FIGURE NO. 2-1
PROCESS DIAGRAM FOR
LANDFILL GAS COMPRESSION SKID

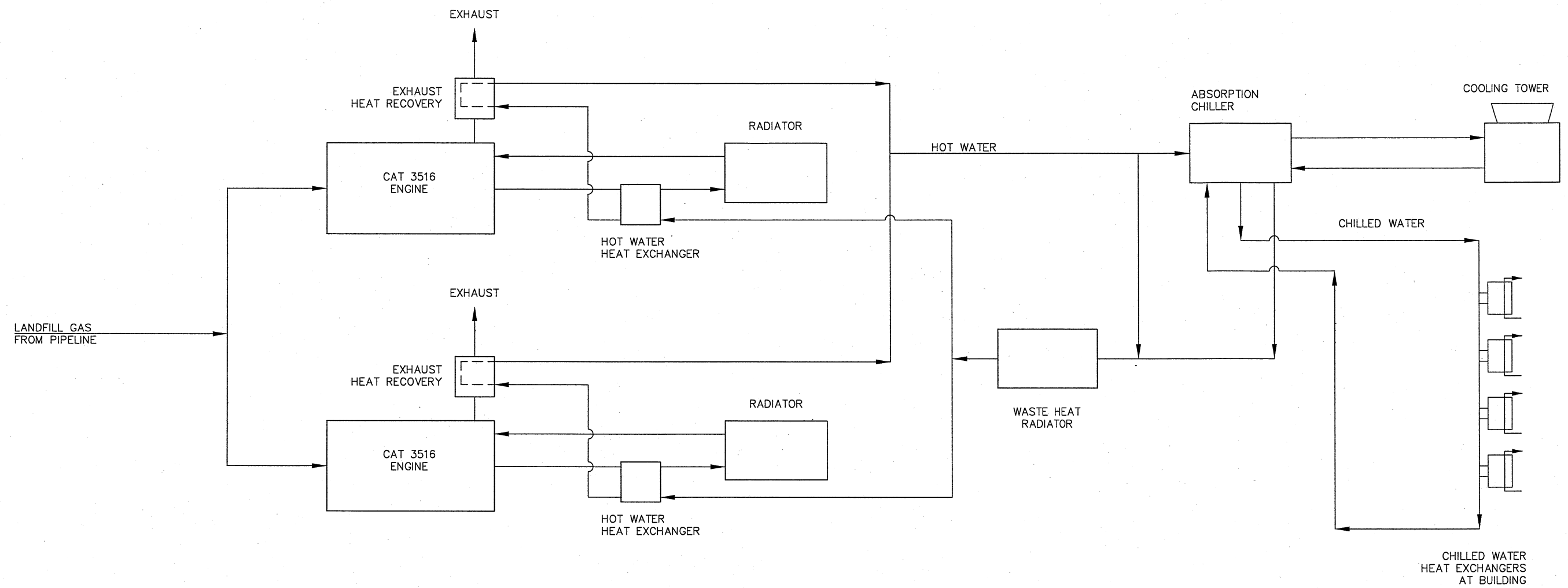


FIGURE NO. 2-2
PROCESS DIAGRAM FOR CHP PLANT

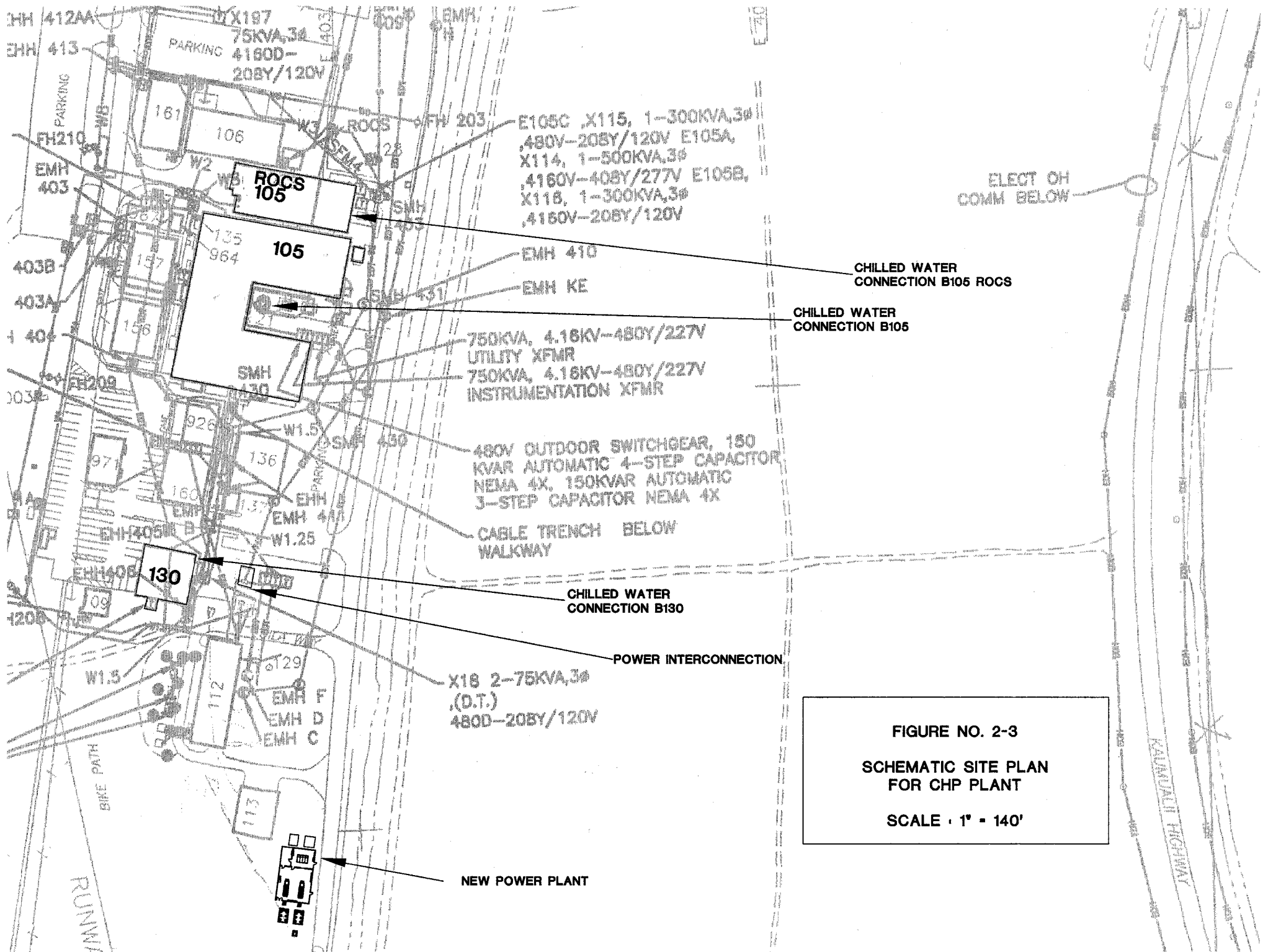
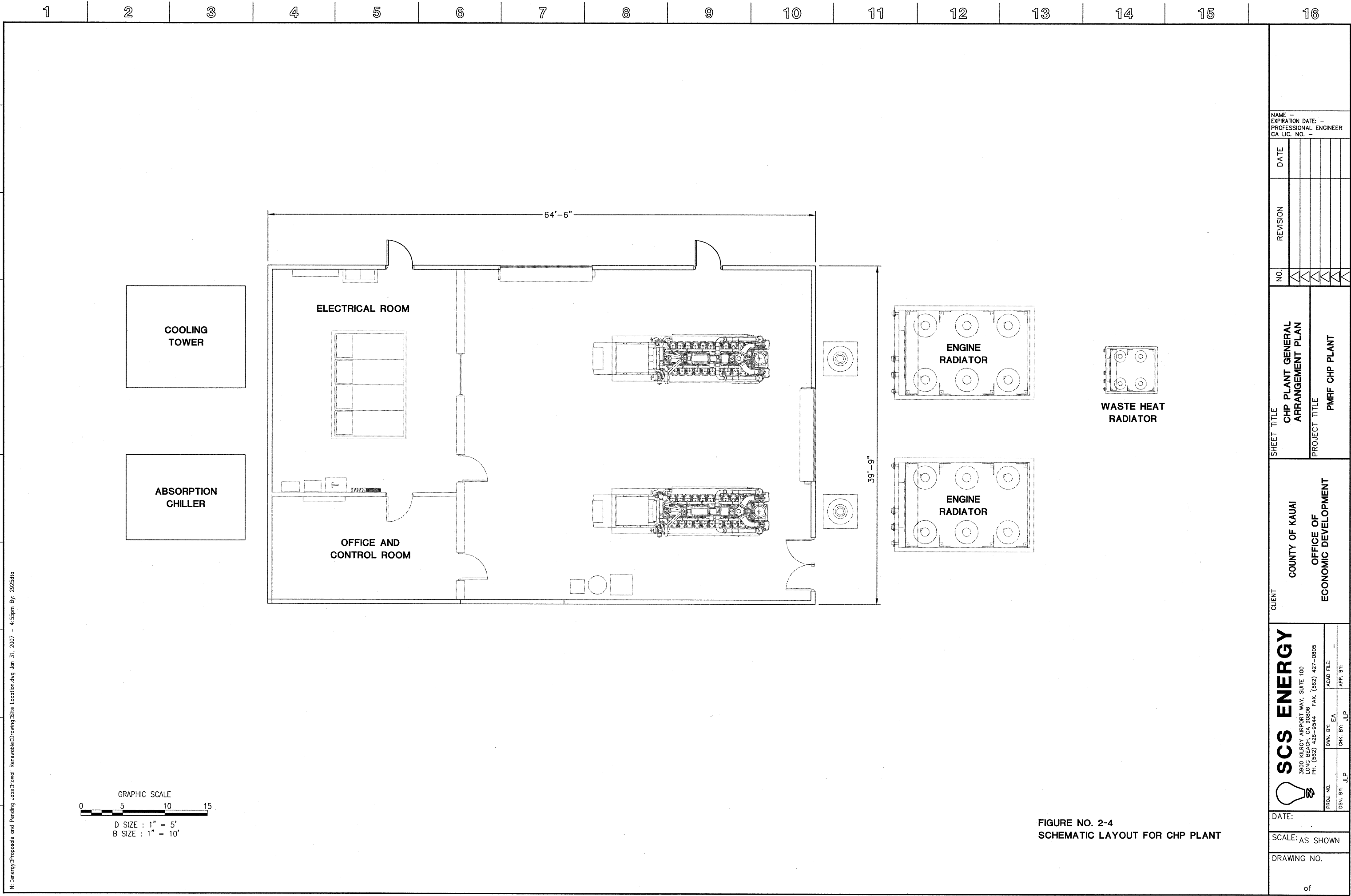


FIGURE NO. 2-3
SCHEMATIC SITE PLAN
FOR CHP PLANT
SCALE : 1" = 140'



N:\Energy\Proposals and Pending Jobs\Hawaii\ Renewable\Drawing Site Location.dwg Jun 31, 2007 - 4:55pm By: 2925dta

FIGURE NO. 2-4
SCHEMATIC LAYOUT FOR CHP PLANT

SECTION 3

ECONOMIC FEASIBILITY

Refined Cost Estimates

Table Nos. 3-1 and 3-2 present refined estimates of construction and operation/maintenance costs for the recommended plan.

Financial Model Runs

Table Nos. 3-3 through 3-5 are financial model run outputs for the recommended plan at a fixed landfill gas sale price of \$1.00/mmBtu and at three different standby power costs (\$5.00/kW; \$10.45/kW; and \$37.47/kW).

Table Nos. 3-6 through 3-8 are financial model run outputs for three other landfill gas sale prices -- \$2.00/mmBtu; \$3.00/mmBtu; and \$4.00/mmBtu. In these model runs, the standby power cost was held constant at the medium standby power cost of \$10.45/kW.

The financial models calculate internal rate of return as a measure of financial performance. The project is financially feasible under all of the scenarios that were evaluated.

The power sales rate for sale of power to KIUC (17.5¢/kWh) is the rate KIUC was willing to pay cogenerators for power under KIUC's Schedule Q in 2006.

TABLE NO. 3-1
REFINED CONSTRUCTION COST ESTIMATE
FOR THE RECOMMENDED PLAN

<i>Major Mechanical Equipment</i>	
Reciprocating Engines	\$1,350,000
Chillers	\$405,000
Heat Exchangers	\$115,000
Pumps	\$22,000
Landfill Gas Skid	\$460,000
<i>Piping and Related</i>	
Landfill Gas Piping	\$654,000
Hot Water Piping	\$42,900
Warm Water Piping	\$22,100
Chilled Water Piping	\$104,000
Other Piping	\$162,500
Chilled Water Conversions	\$23,000
<i>Civil</i>	
Grading/Site Work	\$104,000
Foundations	\$182,000
Buildings	\$175,500
<i>Electrical</i>	
Transformers	\$52,000
Switchgear	\$357,000
PMRF Grid Improvements	\$1,230,000
Power Conduit/Cable	\$331,500
Control Conduit/Cable	\$162,500
Control System	\$143,000
<i>Landfill Gas Collection System</i>	
Landfill Gas Collection System	\$479,000
<i>Engineering/Technical</i>	
Permits	\$45,000
Detailed Design	\$370,000
Construction Observation	\$166,000
Total	\$7,158,000
Contingency (15%)	\$1,073,700
GRAND TOTAL	\$8,231,700

TABLE NO. 3-2
REFINED ESTIMATE OF ANNUAL OPERATION/MAINTENANCE COSTS
FOR THE RECOMMENDED PLAN

Labor	\$178,000
Equipment Maintenance	
Engine/Generators (Levelized)	\$110,000
Landfill Gas Skid	\$10,000
Heat Recovery/Chilled Water	\$20,000
Electric Power	\$180,000
Other Consumables	\$20,000
Insurance	\$50,000
Miscellaneous	\$20,000
TOTAL ANNUAL	\$588,000

TABLE NO. 3-3
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$1.00/MMBTU AND WITH LOW STANDBY POWER CHARGE (\$5.00/kW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489	
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489	
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402	
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402	
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516	
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307	
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603	
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995	
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279	
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706	
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304	
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514	
LFG PURCHASE PRICE (\$/mmBtu)	\$1.00	\$1.03	\$1.06	\$1.09	\$1.13	\$1.16	\$1.19	\$1.23	\$1.27	\$1.30	\$1.34	\$1.38	\$1.43	\$1.47	\$1.51	\$1.56	\$1.60	\$1.65	\$1.70	\$1.75	
ANNUAL LFG COST	\$103,627	\$143,490	\$150,128	\$157,302	\$163,947	\$168,865	\$173,931	\$179,149	\$184,524	\$190,060	\$195,761	\$201,634	\$207,683	\$213,914	\$218,483	\$216,660	\$214,924	\$212,888	\$211,369	\$209,568	
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062	
STANDBY POWER CHARGE (\$/kW)	\$5.00	\$5.15	\$5.30	\$5.46	\$5.63	\$5.80	\$5.97	\$6.15	\$6.33	\$6.52	\$6.72	\$6.92	\$7.13	\$7.34	\$7.56	\$7.79	\$8.02	\$8.26	\$8.51	\$8.77	
STANDBY POWER COST	\$91,512	\$94,257	\$97,085	\$99,998	\$102,998	\$106,087	\$109,270	\$112,548	\$115,925	\$119,402	\$122,984	\$126,674	\$130,474	\$134,388	\$138,420	\$142,573	\$146,850	\$151,255	\$155,793	\$160,467	
TOTAL O+M COST	\$783,139	\$843,387	\$871,022	\$899,823	\$928,744	\$956,606	\$985,304	\$1,014,863	\$1,045,309	\$1,076,669	\$1,108,969	\$1,142,238	\$1,176,505	\$1,211,800	\$1,246,306	\$1,275,318	\$1,305,341	\$1,336,018	\$1,368,193	\$1,401,096	
NET REVENUE	\$2,089,384	\$2,686,056	\$2,799,148	\$2,920,330	\$3,034,766	\$3,125,809	\$3,219,583	\$3,316,171	\$3,415,656	\$3,518,126	\$3,623,669	\$3,732,380	\$3,844,351	\$3,959,681	\$4,052,720	\$4,057,595	\$4,064,580	\$4,068,331	\$4,080,243	\$4,089,208	
GROSS PLANT CAPACITY (kW)	1,640	INITIAL LFG COST (\$/mmBtu)				\$1.00	CAPITAL COST				\$8,231,700										
PLANT NET CAPACITY (kW)	1,525	LFG COST ESCALATION				3%															
PLANT AVAILABILITY	93%					PRE-TAX IRR				33.1%											
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720	INITIAL ANNUAL O+M COST				\$588,000															
		O+M COST ESCALATION				3%															
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																				
KIUC POWER SALES RATE (\$/kWh)	\$0.175	STANDBY POWER CHARGE				\$5.00															
DIESEL FUEL COST \$/GALLON)	\$2.440	CHARGE ESCALATION				3%															
POWER SALES RATE ESCALATION	3%																				

TABLE NO. 3-4
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$1.00/MMBTU AND WITH MEDIUM STANDBY POWER CHARGE (\$10.45/KW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514
LFG PURCHASE PRICE (\$/mmBtu)	\$1.00	\$1.03	\$1.06	\$1.09	\$1.13	\$1.16	\$1.19	\$1.23	\$1.27	\$1.30	\$1.34	\$1.38	\$1.43	\$1.47	\$1.51	\$1.56	\$1.60	\$1.65	\$1.70	\$1.75
ANNUAL LFG COST	\$103,627	\$143,490	\$150,128	\$157,302	\$163,947	\$168,865	\$173,931	\$179,149	\$184,524	\$190,060	\$195,761	\$201,634	\$207,683	\$213,914	\$218,483	\$216,660	\$214,924	\$212,888	\$211,369	\$209,568
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062
STANDBY POWER CHARGE (\$/kW)	\$10.45	\$10.76	\$11.09	\$11.42	\$11.76	\$12.11	\$12.48	\$12.85	\$13.24	\$13.63	\$14.04	\$14.47	\$14.90	\$15.35	\$15.81	\$16.28	\$16.77	\$17.27	\$17.79	\$18.32
STANDBY POWER COST	\$191,260	\$196,998	\$202,908	\$208,995	\$215,265	\$221,723	\$228,375	\$235,226	\$242,283	\$249,551	\$257,038	\$264,749	\$272,691	\$280,872	\$289,298	\$297,977	\$306,916	\$316,124	\$325,607	\$335,376
TOTAL O+M COST	\$882,887	\$946,127	\$976,845	\$1,008,821	\$1,041,011	\$1,072,241	\$1,104,409	\$1,137,541	\$1,171,667	\$1,206,817	\$1,243,022	\$1,280,312	\$1,318,722	\$1,358,283	\$1,397,183	\$1,430,722	\$1,465,407	\$1,500,886	\$1,538,008	\$1,576,005
NET REVENUE	\$1,989,636	\$2,583,315	\$2,693,326	\$2,811,333	\$2,922,499	\$3,010,174	\$3,100,479	\$3,193,493	\$3,289,298	\$3,387,977	\$3,489,616	\$3,594,305	\$3,702,134	\$3,813,198	\$3,901,842	\$3,902,191	\$3,904,513	\$3,903,463	\$3,910,429	\$3,914,299
GROSS PLANT CAPACITY (kW)	1,640	INITIAL LFG COST (\$/mmBtu)				\$1.00	CAPITAL COST				\$8,231,700									
PLANT NET CAPACITY (kW)	1,525	LFG COST ESCALATION				3%														
PLANT AVAILABILITY	93%						PRE-TAX IRR				31.8%									
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720	INITIAL ANNUAL O+M COST				\$588,000														
		O+M COST ESCALATION				3%														
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																			
KIUC POWER SALES RATE (\$/kWh)	\$0.175	STANDBY POWER CHARGE				\$10.45														
DIESEL FUEL COST \$/GALLON)	\$2.440	CHARGE ESCALATION				3%														
POWER SALES RATE ESCALATION	3%																			

TABLE NO. 3-5
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$1.00/MMBTU AND WITH HIGH STANDBY POWER CHARGE (\$37.47/KW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514
LFG PURCHASE PRICE (\$/mmBtu)	\$1.00	\$1.03	\$1.06	\$1.09	\$1.13	\$1.16	\$1.19	\$1.23	\$1.27	\$1.30	\$1.34	\$1.38	\$1.43	\$1.47	\$1.51	\$1.56	\$1.60	\$1.65	\$1.70	\$1.75
ANNUAL LFG COST	\$103,627	\$143,490	\$150,128	\$157,302	\$163,947	\$168,865	\$173,931	\$179,149	\$184,524	\$190,060	\$195,761	\$201,634	\$207,683	\$213,914	\$218,483	\$216,660	\$214,924	\$212,888	\$211,369	\$209,568
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062
STANDBY POWER CHARGE (\$/kW)	\$37.47	\$38.59	\$39.75	\$40.94	\$42.17	\$43.44	\$44.74	\$46.08	\$47.47	\$48.89	\$50.36	\$51.87	\$53.42	\$55.03	\$56.68	\$58.38	\$60.13	\$61.93	\$63.79	\$65.70
STANDBY POWER COST	\$685,791	\$706,365	\$727,556	\$749,382	\$771,864	\$795,020	\$818,870	\$843,436	\$868,739	\$894,802	\$921,646	\$949,295	\$977,774	\$1,007,107	\$1,037,320	\$1,068,440	\$1,100,493	\$1,133,508	\$1,167,513	\$1,202,539
TOTAL O+M COST	\$1,377,418	\$1,455,494	\$1,501,493	\$1,549,208	\$1,597,610	\$1,645,538	\$1,694,904	\$1,745,751	\$1,798,124	\$1,852,068	\$1,907,630	\$1,964,859	\$2,023,804	\$2,084,519	\$2,145,206	\$2,201,185	\$2,258,984	\$2,318,271	\$2,379,913	\$2,443,168
NET REVENUE	\$1,495,105	\$2,073,948	\$2,168,678	\$2,270,945	\$2,365,900	\$2,436,877	\$2,509,983	\$2,585,283	\$2,662,841	\$2,742,726	\$2,825,008	\$2,909,759	\$2,997,051	\$3,086,963	\$3,153,820	\$3,131,728	\$3,110,936	\$3,086,079	\$3,068,523	\$3,047,136
GROSS PLANT CAPACITY (kW)	1,640	INITIAL LFG COST (\$/mmBtu)				\$1.00	CAPITAL COST				\$8,231,700									
PLANT NET CAPACITY (kW)	1,525	LFG COST ESCALATION				3%														
PLANT AVAILABILITY	93%						PRE-TAX IRR				25.6%									
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720	INITIAL ANNUAL O+M COST				\$588,000														
		O+M COST ESCALATION				3%														
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																			
KIUC POWER SALES RATE (\$/kWh)	\$0.175	STANDBY POWER CHARGE				\$37.47														
DIESEL FUEL COST \$/GALLON)	\$2.440	CHARGE ESCALATION				3%														
POWER SALES RATE ESCALATION	3%																			

TABLE NO. 3-6
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$2.00/MMBTU AND WITH MEDIUM STANDBY POWER CHARGE (\$10.45/KW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514
LFG PURCHASE PRICE (\$/mmBtu)	\$2.00	\$2.06	\$2.12	\$2.19	\$2.25	\$2.32	\$2.39	\$2.46	\$2.53	\$2.61	\$2.69	\$2.77	\$2.85	\$2.94	\$3.03	\$3.12	\$3.21	\$3.31	\$3.40	\$3.51
ANNUAL LFG COST	\$207,255	\$286,979	\$300,256	\$314,605	\$327,894	\$337,731	\$347,863	\$358,299	\$369,048	\$380,119	\$391,523	\$403,268	\$415,366	\$427,827	\$436,965	\$433,320	\$429,848	\$425,777	\$422,739	\$419,135
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062
STANDBY POWER CHARGE (\$/kW)	\$10.45	\$10.76	\$11.09	\$11.42	\$11.76	\$12.11	\$12.48	\$12.85	\$13.24	\$13.63	\$14.04	\$14.47	\$14.90	\$15.35	\$15.81	\$16.28	\$16.77	\$17.27	\$17.79	\$18.32
STANDBY POWER COST	\$191,260	\$196,998	\$202,908	\$208,995	\$215,265	\$221,723	\$228,375	\$235,226	\$242,283	\$249,551	\$257,038	\$264,749	\$272,691	\$280,872	\$289,298	\$297,977	\$306,916	\$316,124	\$325,607	\$335,376
TOTAL O+M COST	\$986,515	\$1,089,617	\$1,126,973	\$1,166,123	\$1,204,958	\$1,241,107	\$1,278,340	\$1,316,690	\$1,356,191	\$1,396,877	\$1,438,783	\$1,481,946	\$1,526,405	\$1,572,197	\$1,615,666	\$1,647,382	\$1,680,331	\$1,713,775	\$1,749,377	\$1,785,573
NET REVENUE	\$1,886,009	\$2,439,826	\$2,543,198	\$2,654,030	\$2,758,552	\$2,841,308	\$2,926,548	\$3,014,344	\$3,104,774	\$3,197,918	\$3,293,855	\$3,392,671	\$3,494,451	\$3,599,284	\$3,683,360	\$3,685,531	\$3,689,590	\$3,690,574	\$3,699,059	\$3,704,732
GROSS PLANT CAPACITY (kW)	1,640		INITIAL LFG COST (\$/mmBtu)			\$2.00		CAPITAL COST			\$8,231,700									
PLANT NET CAPACITY (kW)	1,525		LFG COST ESCALATION			3%														
PLANT AVAILABILITY	93%							PRE-TAX IRR			30.2%									
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720		INITIAL ANNUAL O+M COST			\$588,000														
			O+M COST ESCALATION			3%														
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																			
KIUC POWER SALES RATE (\$/kWh)	\$0.175		STANDBY POWER CHARGE			\$10.45														
DIESEL FUEL COST \$/GALLON)	\$2.440		CHARGE ESCALATION			3%														
POWER SALES RATE ESCALATION	3%																			

TABLE NO. 3-7
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$3.00/MMBTU AND WITH MEDIUM STANDBY POWER CHARGE (\$10.45/KW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514
LFG PURCHASE PRICE (\$/mmBtu)	\$3.00	\$3.09	\$3.18	\$3.28	\$3.38	\$3.48	\$3.58	\$3.69	\$3.80	\$3.91	\$4.03	\$4.15	\$4.28	\$4.41	\$4.54	\$4.67	\$4.81	\$4.96	\$5.11	\$5.26
ANNUAL LFG COST	\$310,882	\$430,469	\$450,384	\$471,907	\$491,841	\$506,596	\$521,794	\$537,448	\$553,571	\$570,179	\$587,284	\$604,902	\$623,049	\$641,741	\$655,448	\$649,980	\$644,771	\$638,665	\$634,108	\$628,703
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062
STANDBY POWER CHARGE (\$/kW)	\$10.45	\$10.76	\$11.09	\$11.42	\$11.76	\$12.11	\$12.48	\$12.85	\$13.24	\$13.63	\$14.04	\$14.47	\$14.90	\$15.35	\$15.81	\$16.28	\$16.77	\$17.27	\$17.79	\$18.32
STANDBY POWER COST	\$191,260	\$196,998	\$202,908	\$208,995	\$215,265	\$221,723	\$228,375	\$235,226	\$242,283	\$249,551	\$257,038	\$264,749	\$272,691	\$280,872	\$289,298	\$297,977	\$306,916	\$316,124	\$325,607	\$335,376
TOTAL O+M COST	\$1,090,142	\$1,233,107	\$1,277,101	\$1,323,426	\$1,368,905	\$1,409,972	\$1,452,271	\$1,495,840	\$1,540,715	\$1,586,936	\$1,634,544	\$1,683,581	\$1,734,088	\$1,786,111	\$1,834,149	\$1,864,042	\$1,895,255	\$1,926,663	\$1,960,746	\$1,995,140
NET REVENUE	\$1,782,382	\$2,296,336	\$2,393,070	\$2,496,728	\$2,594,605	\$2,672,443	\$2,752,616	\$2,835,195	\$2,920,251	\$3,007,858	\$3,098,094	\$3,191,037	\$3,286,768	\$3,385,371	\$3,464,877	\$3,468,871	\$3,474,666	\$3,477,686	\$3,487,690	\$3,495,164
GROSS PLANT CAPACITY (kW)	1,640		INITIAL LFG COST (\$/mmBtu)			\$3.00		CAPITAL COST			\$8,231,700									
PLANT NET CAPACITY (kW)	1,525		LFG COST ESCALATION			3%														
PLANT AVAILABILITY	93%							PRE-TAX IRR			28.5%									
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720		INITIAL ANNUAL O+M COST			\$588,000														
			O+M COST ESCALATION			3%														
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																			
KIUC POWER SALES RATE (\$/kWh)	\$0.175		STANDBY POWER CHARGE			\$10.45														
DIESEL FUEL COST \$/GALLON)	\$2.440		CHARGE ESCALATION			3%														
POWER SALES RATE ESCALATION	3%																			

TABLE NO. 3-8
PMRF CHP PROJECT
LFG PURCHASE PRICE OF \$4.00/MMBTU AND WITH MEDIUM STANDBY POWER CHARGE (\$10.45/KW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LFG AVAILABLE AT 50% METHANE (scfm)	424	570	579	589	599	610	622	634	743	715	688	663	638	614	591	569	548	527	508	489
LFG REQUIRED AT 50% METHANE (scfm)	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
LFG CONSUMED AT 50% METHANE (scfm)	424	570	579	589	596	596	596	596	596	596	596	596	596	596	591	569	548	527	508	489
TOTAL POWER PRODUCTION (kWh/yr)	8,841,919	11,886,543	12,074,225	12,282,761	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,428,736	12,324,468	11,865,689	11,427,764	10,989,839	10,593,620	10,197,402
AVOIDED KIUC POWER PURCHASES (kWh/yr)	8,841,919	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000	9,021,000
EXCESS POWER TO KIUC (kWh/yr)	0	2,865,543	3,053,225	3,261,761	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,407,736	3,303,468	2,844,689	2,406,764	1,968,839	1,572,620	1,176,402
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294	\$0.303	\$0.312	\$0.321	\$0.331	\$0.341	\$0.351	\$0.362	\$0.372	\$0.384	\$0.395	\$0.407	\$0.419	\$0.432	\$0.445	\$0.458	\$0.472	\$0.486	\$0.501	\$0.516
KIUC POWER SALES RATE (\$/kWh)	\$0.175	\$0.180	\$0.186	\$0.191	\$0.197	\$0.203	\$0.209	\$0.215	\$0.222	\$0.228	\$0.235	\$0.242	\$0.250	\$0.257	\$0.265	\$0.273	\$0.281	\$0.289	\$0.298	\$0.307
VALUE OF AVOIDED KIUC POWER PURCHASES	\$2,599,524	\$2,731,739	\$2,813,691	\$2,898,102	\$2,985,045	\$3,074,597	\$3,166,834	\$3,261,839	\$3,359,695	\$3,460,486	\$3,564,300	\$3,671,229	\$3,781,366	\$3,894,807	\$4,011,651	\$4,132,001	\$4,255,961	\$4,383,640	\$4,515,149	\$4,650,603
REVENUE FROM POWER SOLD TO KIUC	\$0	\$516,514	\$566,854	\$623,737	\$671,201	\$691,337	\$712,078	\$733,440	\$755,443	\$778,106	\$801,450	\$825,493	\$850,258	\$875,766	\$874,439	\$775,588	\$675,876	\$569,483	\$468,524	\$360,995
DIESEL FUEL COST (\$/GALLON)	\$2.440	\$2.513	\$2.589	\$2.666	\$2.746	\$2.829	\$2.913	\$3.001	\$3.091	\$3.184	\$3.279	\$3.378	\$3.479	\$3.583	\$3.691	\$3.801	\$3.915	\$4.033	\$4.154	\$4.279
DIESEL FUEL SAVINGS	\$272,999	\$281,189	\$289,625	\$298,314	\$307,263	\$316,481	\$325,976	\$335,755	\$345,827	\$356,202	\$366,888	\$377,895	\$389,232	\$400,909	\$412,936	\$425,324	\$438,084	\$451,226	\$464,763	\$478,706
TOTAL POWER REVENUE AND SAVINGS	\$2,872,524	\$3,529,443	\$3,670,171	\$3,820,153	\$3,963,510	\$4,082,415	\$4,204,888	\$4,331,034	\$4,460,965	\$4,594,794	\$4,732,638	\$4,874,617	\$5,020,856	\$5,171,481	\$5,299,026	\$5,332,913	\$5,369,921	\$5,404,349	\$5,448,436	\$5,490,304
ANNUAL LFG CONSUMED (mmBtu/yr)	103,627	139,310	141,510	143,954	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	145,665	144,443	139,066	133,933	128,801	124,157	119,514
LFG PURCHASE PRICE (\$/mmBtu)	\$4.00	\$4.12	\$4.24	\$4.37	\$4.50	\$4.64	\$4.78	\$4.92	\$5.07	\$5.22	\$5.38	\$5.54	\$5.70	\$5.87	\$6.05	\$6.23	\$6.42	\$6.61	\$6.81	\$7.01
ANNUAL LFG COST	\$414,509	\$573,958	\$600,511	\$629,209	\$655,788	\$675,462	\$695,725	\$716,597	\$738,095	\$760,238	\$783,045	\$806,537	\$830,733	\$855,655	\$873,931	\$866,640	\$859,695	\$851,553	\$845,478	\$838,271
NON-FUEL O+M COST	\$588,000	\$605,640	\$623,809	\$642,523	\$661,799	\$681,653	\$702,103	\$723,166	\$744,861	\$767,207	\$790,223	\$813,930	\$838,347	\$863,498	\$889,403	\$916,085	\$943,567	\$971,874	\$1,001,031	\$1,031,062
STANDBY POWER CHARGE (\$/kW)	\$10.45	\$10.76	\$11.09	\$11.42	\$11.76	\$12.11	\$12.48	\$12.85	\$13.24	\$13.63	\$14.04	\$14.47	\$14.90	\$15.35	\$15.81	\$16.28	\$16.77	\$17.27	\$17.79	\$18.32
STANDBY POWER COST	\$191,260	\$196,998	\$202,908	\$208,995	\$215,265	\$221,723	\$228,375	\$235,226	\$242,283	\$249,551	\$257,038	\$264,749	\$272,691	\$280,872	\$289,298	\$297,977	\$306,916	\$316,124	\$325,607	\$335,376
TOTAL O+M COST	\$1,193,769	\$1,376,596	\$1,427,228	\$1,480,728	\$1,532,852	\$1,578,838	\$1,626,203	\$1,674,989	\$1,725,239	\$1,776,996	\$1,830,306	\$1,885,215	\$1,941,771	\$2,000,024	\$2,052,631	\$2,080,702	\$2,110,179	\$2,139,551	\$2,172,116	\$2,204,708
NET REVENUE	\$1,678,754	\$2,152,846	\$2,242,942	\$2,339,425	\$2,430,658	\$2,503,578	\$2,578,685	\$2,656,045	\$2,735,727	\$2,817,799	\$2,902,333	\$2,989,402	\$3,079,085	\$3,171,457	\$3,246,394	\$3,252,211	\$3,259,742	\$3,264,798	\$3,276,320	\$3,285,596
GROSS PLANT CAPACITY (kW)	1,640	INITIAL LFG COST (\$/mmBtu)				\$4.00	CAPITAL COST				\$8,231,700									
PLANT NET CAPACITY (kW)	1,525	LFG COST ESCALATION				3%														
PLANT AVAILABILITY	93%					PRE-TAX IRR				26.8%										
NET PLANT HEAT RATE (Btu/kWh)(HHV)	11,720	INITIAL ANNUAL O+M COST				\$588,000														
		O+M COST ESCALATION				3%														
RATE FOR POWER USED ON-SITE (\$/kWh)	\$0.294																			
KIUC POWER SALES RATE (\$/kWh)	\$0.175																			
DIESEL FUEL COST \$/GALLON)	\$2.440	STANDBY POWER CHARGE				\$10.45														
POWER SALES RATE ESCALATION	3%	CHARGE ESCALATION				3%														

SECTION 4

OPERATION/MAINTENANCE CONSIDERATIONS

Measurement and Verification Requirements

The most important measurements of performance for this project are:

- Net power output (kW);
- Engine/generator heat rate (Btu/kWh); and
- Air emissions (g/bhp-hr).

The construction contract should require the contractor to guarantee these parameters. Compliance with the guarantees should be determined through an 8-hour performance test, undertaken no later than 30 days after commencement of initial operation of the power plant. Net power output and heat rate would be averaged over the 8-hour period. The air emissions test, a two to four hour test, would be conducted within the 8-hour test window.

Net power output would be measured using the permanent net power output meter housed in the power plant's switchgear. Heat rate would be measured by dividing the observed, average net power output (kWh/hour) by the observed, average fuel consumption. Fuel consumption will be determined using the power plant's permanent inlet flow meter and the plant's continuously recording methane analyzer. Fuel consumption (in mmBtu/hr) would be calculated by multiplying flow rate (scfm) times 60 minutes/hour times methane percentage times 1,012 Btu/ft³, where 1,012 Btu/ft equals the higher heating value of methane.

Air emissions would be measured by a third-party testing firm, using portable equipment.

On an ongoing basis, the net power output and heat rate would be monitored for diagnostic purposes. The net power output might also be used for billing purposes, if PMRF employs an energy services contractor (ESCO) to implement the project, and/or to document the amount of renewable power produced on an ongoing basis.

The fuel consumption (mmBtu) would be used to determine payments due to the County under the landfill gas sale agreement, if compensation to the County was based on actual fuel consumption. Net power output could be used to determine compensation to the County if the landfill gas sale agreement called for compensation on the basis of percent of gross revenue (or revenue equivalent).

The amount of chilled water delivered by the power plant to PMRF is of secondary importance to the project; however, the delivery of chilled water adds value to the project, and measurement

of chilled water delivery is worth identifying as an output to be monitored in routine operation. Chilled water flow (gpm) and temperature (°F) will be monitored using permanent power plant instrumentation, and tons of cooling can be calculated from these measurements. If PMRF engages an ESCO, these measurements may also provide a basis for billing.

The water in and out of the heat exchanger on each engine's exhaust will be continuously monitored to determine if gas side fouling of the heat exchanger is occurring.

Operation/Maintenance Considerations

SCS recommends that the power plant be staffed with two full-time operators. In a typical arrangement, the operators would work five days, eight hours per day, plus be on-call on the evenings and weekends. Alternative configurations are possible. At some of the plants SCS operates, SCS schedules the days on an offset basis (e.g., Sunday through Thursday and Tuesday through Saturday -- allowing for three days when two operators overlap). The operating budget for labor will provide for two operators plus ten percent for overtime hours.

The two operators would handle all scheduled engine maintenance at levels below a top-end overhaul (expected every 12 to 16 months). The local Caterpillar dealer would be called upon to provide additional staff to support the top-end overhauls. The in-frame overhaul (expected every four to five years) would be completely subcontracted to the local Caterpillar dealer.

The landfill gas compression skid would be inspected once per day and it would be monitored in the power plant control room, using the power plant's supervisory control and data acquisition (SCADA) system. The power plant SCADA system would communicate with the compressor skid's programmable logic controller (PLC) using a communication cable laid in the landfill gas transmission pipeline trench.

SECTION 5

PROJECT IMPLEMENTATION PLAN

There are three parties who could have a role in this project -- PMRF, KIUC and the County. PMRF is the energy consumer. PMRF could take responsibility for design, construction and operation of the power plant, or PMRF could assume the role of an energy customer only. If PMRF elects to continue as an energy customer only, then KIUC or the County or a private investor could design, construct and operate the project.

KIUC, being in the energy supply business, is probably the most likely candidate for project ownership, if PMRF elects not to own the project. The least role KIUC would have in the project would be that of a traditional utility, under which KIUC would provide standby power and purchase excess power. As mentioned in prior sections of this report, it may be necessary for PMRF to buy or lease some segments of KIUC power distribution lines, now owned by PMRF, that are located within PMRF.

The County is the owner of the energy resource. The likely role of the County is energy supplier to PMRF or KIUC. The County could bear the cost of wellfield installation as part of their day-to-day landfill operation, or the wellfield could be installed and operated/maintained by the energy purchaser. The County's desire or ability to enter into a sole source landfill gas sale agreement should also be determined. HRS 103D-102(b)(3) might allow the County to proceed with a sole source negotiation. If the County cannot, or desires not to, negotiate with PMRF or KIUC on a sole source basis, then the County must solicit proposals from any interested party using an advertised Request for Proposals.

As a first step in project development, PMRF, KIUC and the County should meet to discuss their potential roles in the project and execute a Memorandum of Understanding (MOU) to govern their agreed-upon relationship.

Work Plan for Future Tasks

The following steps are necessary to implement the project. The presumption has been made that PMRF will design, finance, own and operate the facilities associated with the project, or will engage an ESCO to implement the project on their behalf. If PMRF decides to employ an ESCO, then the additional step of selecting an ESCO needs to be added as the first step in the implementation plan.

- Negotiate a landfill gas sale agreement with the County;
- Negotiate with KIUC to obtain ownership of use of a few KIUC-owned power distribution line segments in the Navy Housing area;

- Design the landfill gas wellfield, the compressor skid, the landfill gas transmission line and the CHP power plant;
- File for and obtain a Hawaii Department of Health air permit for the engines;
- Prepare other environmental documentation;
- Obtain bids for construction;
- Construct the facilities;
- Perform startup and performance testing; and
- Commence commercial operation.

Negotiate a Landfill Gas Sale Agreement

The construction and operation/maintenance costs for the project assume that PMRF will install and operate the landfill gas collection system and compressor skid. The price paid to the County for the landfill gas must take into consideration the fact that PMRF, rather than the County, paid for these facilities. An alternative approach would be for the County to install and operate these facilities, and the price paid by PMRF to the County for the landfill gas would then be expected to be higher.

While compensation to the County could take several forms, the most common forms of compensation in the landfill gas to energy business are:

- The County would be paid on a \$/mmBtu basis, using an agreed-upon \$/mmBtu rate and actual mmBtu consumed (on a monthly basis); or
- The County would be paid on a percent of gross revenue basis (a percentage of the value of the power produced).

The second approach would be more difficult to employ, since the value of the power produced is based on net avoided cost, plus some power sale to KIUC, as compared to 100 percent power sale to KIUC, where the actual value of the power produced would be clearly known.

Negotiate with KIUC on Power Distribution Lines

As discussed in the Interim Report on Task 3, KIUC and PMRF have mixed ownership of the power distribution lines in the Navy Housing area. Most of the power distribution lines are owned by PMRF; however, the power distribution system is incomplete without KIUC's lines. There are five possible resolutions to this issue:

- KIUC could give the lines to PMRF;

- KIUC could sell the lines to PMRF;
- KIUC could lease the lines to PMRF;
- PMRF could install its own power distribution lines in the “missing” segments; or
- Service to the Navy Housing area could be eliminated from the project.

While elimination of the Navy Housing area will adversely impact project revenues, the impact on the project’s financial viability will not be that great since a \$1.23 million investment in a new power transmission line between the PMRF power plant and the Navy Housing area would be eliminated, and the power not consumed in the Navy Housing area would be sold to KIUC, albeit at a lower value.

During the discussions with KIUC about their power distribution lines in the Navy Housing area, PMRF should inquire as to whether KIUC would be willing to wheel (transmit) power from the PMRF power plant to the Navy Housing area through KIUC’s existing, off-site distribution lines, and at what price KIUC would be willing to provide that service. It may be more cost-effective to pay KIUC for wheeling than to construct a \$1.23 million power transmission line on-site.

Design Landfill Gas to Energy Facilities

The design of the project will be relatively straightforward since:

- With the exception of about 200 feet of pipeline, the landfill gas transmission pipeline is located on property owned by PMRF. The remaining 200 feet is on property owned by the County. The acquisition of rights-of-ways is not an obstacle to be overcome on this project; and
- The CHP power plant will use proven equipment and technologies. There are more than 200 landfill gas fired reciprocating engine power plants in operation in the United States. There are almost 100 landfill gas compressor skids and pipelines in operation in the United States.

The package of design drawings would include: flow sheets; piping and instrumentation diagrams; single line diagrams; site plans; building plans; mechanical equipment plans; piping plans; conduit and cable schedules; electrical equipment plans; conduit routing plans; and control system architecture drawings. Complete equipment and installation specifications would accompany the design drawings.

Obtain Air Permits and Other Environmental Approvals

The principal permit to be obtained for this project is an air permit from the Hawaii Department of Health (HDH). The proposed power plant will be located in an attainment area. As long as the power plant employs Best Available Control Technology (BACT), as is currently proposed, issuance of an air permit should be straightforward. If the power plant is owned by an ESCO, the ESCO would obtain its own permit.

The landfill is not currently large enough to be subject to USEPA's New Source Standards for Municipal Solid Waste Landfills (NSPS). For this reason, installation of a landfill gas collection system is optional, and a backup flare is not being installed. If the landfill becomes subject to NSPS in the future, the County will probably be required by HDH to install a backup flare.

It is believed that the need for an overall environmental review of the project can be satisfied by obtaining a negative declaration or a mitigated negative declaration. An environmental assessment, a brief summary of the project's net environmental impacts, must be prepared to support obtaining such a declaration.

Obtain Bids for Construction

Construction bids would be obtained through a formal, advertised solicitation, if PMRF owns the project, or through a less formal bidding process, if an ESCO owns the project. In either case, construction of the power plant, landfill gas transmission pipeline and compression skid, and the power transmission line improvements could be awarded to a single contractor or multiple contractors.

Construct the Facilities

Construction of the facilities would be undertaken by a contractor or contractors under the inspection of PMRF or the ESCO. Construction of a project of this type and magnitude would take about 12 months.

Startup and Performance Testing

The contractor or contractors would be responsible for achieving full mechanical completion, commissioning and full functional testing of the individual components of the project. PMRF or the ESCO would jointly conduct the performance tests with the constructor or contractors.

Commercial Operation

If the facilities were owned by PMRF, PMRF would probably engage a contractor to operate the facilities. The contract could be a new contract or could be an amendment to the contract PMRF currently has for operation of the current power plant. It is anticipated that the existing PMRF power plant would remain available to provide standby power. If the operation of the new power plant was combined with the operation of the existing PMRF power plant, it will be possible to achieve some synergy, and perhaps labor cost savings, that were not considered in the costs estimated in this report.

If an ESCO is selected to implement the project, it may be desirable to have the same ESCO assume responsibility for operating the existing PMRF power plant.

Project Development Schedule

Figure No. 5-1 presents a project development schedule. It anticipates commercial operation commencing on December 31, 2008.

Barriers to Implementation

There are no barriers to implementation of the project; however, the most contentious issues on a landfill gas to energy project are:

- 1) Negotiation of the landfill gas sale agreement; and
- 2) Project financing.

The second item appears to be the lesser of the two issues. If PMRF cannot obtain a capital authorization from the Navy, it could use an ESCO, who would commit his own capital to the project. Nevertheless, the ability of the Navy to secure funding and the correct type of funding could become a barrier to Navy implementation.

The first item is often a complex issue if a governmental entity, rather than a private enterprise, owns the landfill which will supply the landfill gas. The actual text of the landfill gas sale agreement is not difficult to develop, since templates from hundreds of operating landfill gas to energy projects exist in the public domain. The complexity involves two sub-issues:

- Does the sale of the landfill gas require that the right to use the landfill gas be offered to any party, through a formal request for proposal process, or is it possible to negotiate with a single party? (in this case PMRF or their ESCO); and
- The price to be paid for the landfill gas.

**FIGURE NO. 5-1
PROJECT DEVELOPMENT SCHEDULE
PROPOSED PMRF CHP PROJECT**

